Programs in Ladder Logic

PLC on a chip™ Embedded

PLC on a Chip Patent 7,299,099

HEC-20XX Technical User's Manual

(For Models 2000, 2001, 2002, 2003)

REV .2

Divelbiss CORPORATION

Smart Parts for Managing Automation

9778 Mt. Gilead Rd.
Fredericktown, OH 43019
Toll Free: 1-800-245-2327
Web: http://www.divelbiss.com
Email: sales@divelbiss.com

2008004.2

TABLE OF CONTENTS

Table of Contents	Page 1
Getting Started	Page 2
How to Use this Manual	Page 3
Configuring the HEC Target in EZ LADDER	Page 4
Configuring PWM Properties	Page 4
HEC Features	Page 7
Getting to Know the HEC	Page 8
HEC Mounting	Page 9
HEC Input Power	Page 9
Watchdog LED	Page 10
Programming Port	Page 10
General Purpose Serial Port	Page 11
CAN Ports	Page 12
Digital Inputs	Page 13
Counter Inputs	Page 14
Digital Outputs	Page 14
PWM Outputs	Page 15
Specifications	Page 16

WARNING!

The HEC-20XX, as with programmable controllers, must not be used alone in applications which would be hazardous to personnel in the event of failure of this device. Precautions must be taken by the user to provide mechanical and/or electrical safeguards external to this device. This device is NOT APPROVED for domestic or human medical use.

Divelbiss Corporation ● 9778 Mt. Gilead Rd. ● Fredericktown, Ohio 43019 ● 1-800-245-2327 ● www.divelbiss.com

GETTING STARTED

This section explains how to read this manual and understand the symbols.

HOW TO USE THIS MANUAL

In this manual, the following conventions are used to distinguish elements of text:

BOLD	Denotes labeling, commands, and literal portions of syntax that must appear exactly as shown.
italic	Used for variables and placeholders that represent the type of text to be entered by the user.
SMALL CAPS	Used to show key sequences or actual buttons, such as OK, where the user clicks the OK button.

In addition, the following symbols appear periodically in the left margin to call the readers attention to specific details in the text:

Warns the reader of a potential danger or hazard that is associated with certain actions.

Appears when the text contains a tip that is especially helpful.

Indicates that the text contains information to which the reader should pay particularly close attention.

CONFIGURING THE HEC-20XX TARGET IN EZ LADDER

Before you can program and use the HEC Controller, it must be configured as a target within EZ LADDER. For help with installing or using EZ LADDER, please refer to the EZ LADDER User's Manual.

In EZ LADDER, select **PROJECT**....**SETTINGS**. This will open the *Project Settings Window*. Select "HEC-2000" for the target. Figure 1.1 show the *Project Settings Window*.

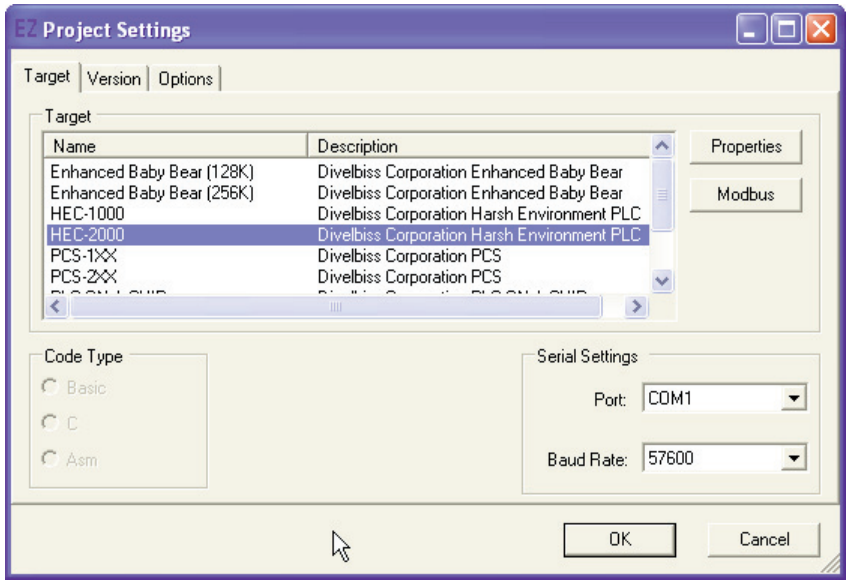


Figure 1.1

CONFIGURING PWM PROPERTIES

The HEC-20XX Controller includes 8 digital outputs. Any of the digital outputs may be used as PWM outputs. To use the digital outputs as PWM channels, the PWM channels must be installed in the EZ LADDER project. Each of the eight outputs may only be used once (as a PWM output or a digital output).

To install PWM Outputs in the target configuration:

1. Use the menu, select **PROJECT**....**SETTINGS**. The *ProjectSettingsForm* dialog will open. Select the target.
2. Click the **PROPERTIES** button.
3. Click the **PWM PROPERTIES** button.
4. The *PWM Properties* window will open. See Figure 1.2.

CONFIGURING PWM PROPERTIES

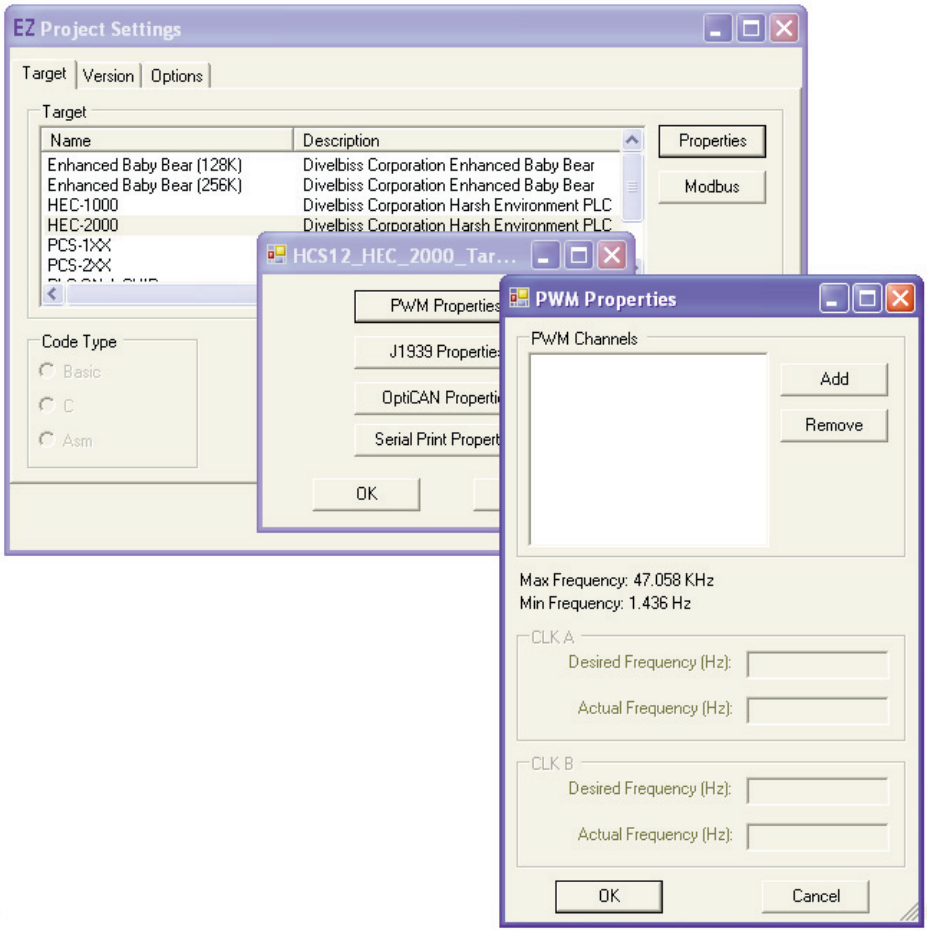


Figure 1.2

5. Click the **ADD** button in the *PWM Properties* window.
6. In the *ADD PWM* dialog, select the channels to install. The channels are as follows:

Digital Output 0 - PWM 0	Digital Output 3 - PWM 4
Digital Output 1 - PWM 1	Digital Output 4 - PWM 5
Digital Output 2 - PWM 2	Digital Output 5 - PWM 6
Digital Output 3 - PWM 3	Digital Output 5 - PWM 7

7. Click **OK** to close the *ADD PWM* dialog. The next step is configuring the frequencies.

8. Enter the desired frequency for Clock A and Clock B (if installed). The HEC-20XX has 8 available PWM Channels. These channels are either controlled with Clock A or Clock B. This allows two different PWM frequencies. The Minimum and Maximum frequencies are displayed in the *PWM Properties* dialog. The frequency for Clock A and Clock B must be in this range. The *ACTUAL FREQUENCY* is what will be seen on the actual PWM hardware output channels (as close as possible to the desired frequency; this is due to limitations of the hardware).

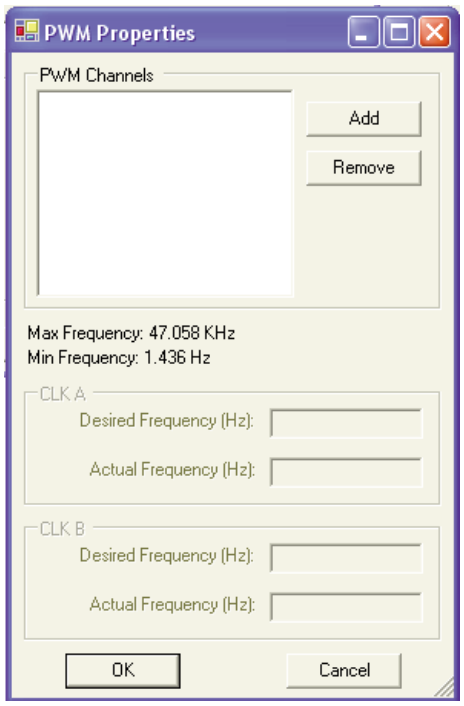


Figure 1.3

9. Click **OK** to close the *PWM Properties* and save the changes.

11. Click **OK** to close the *Target Properties* and save the changes.

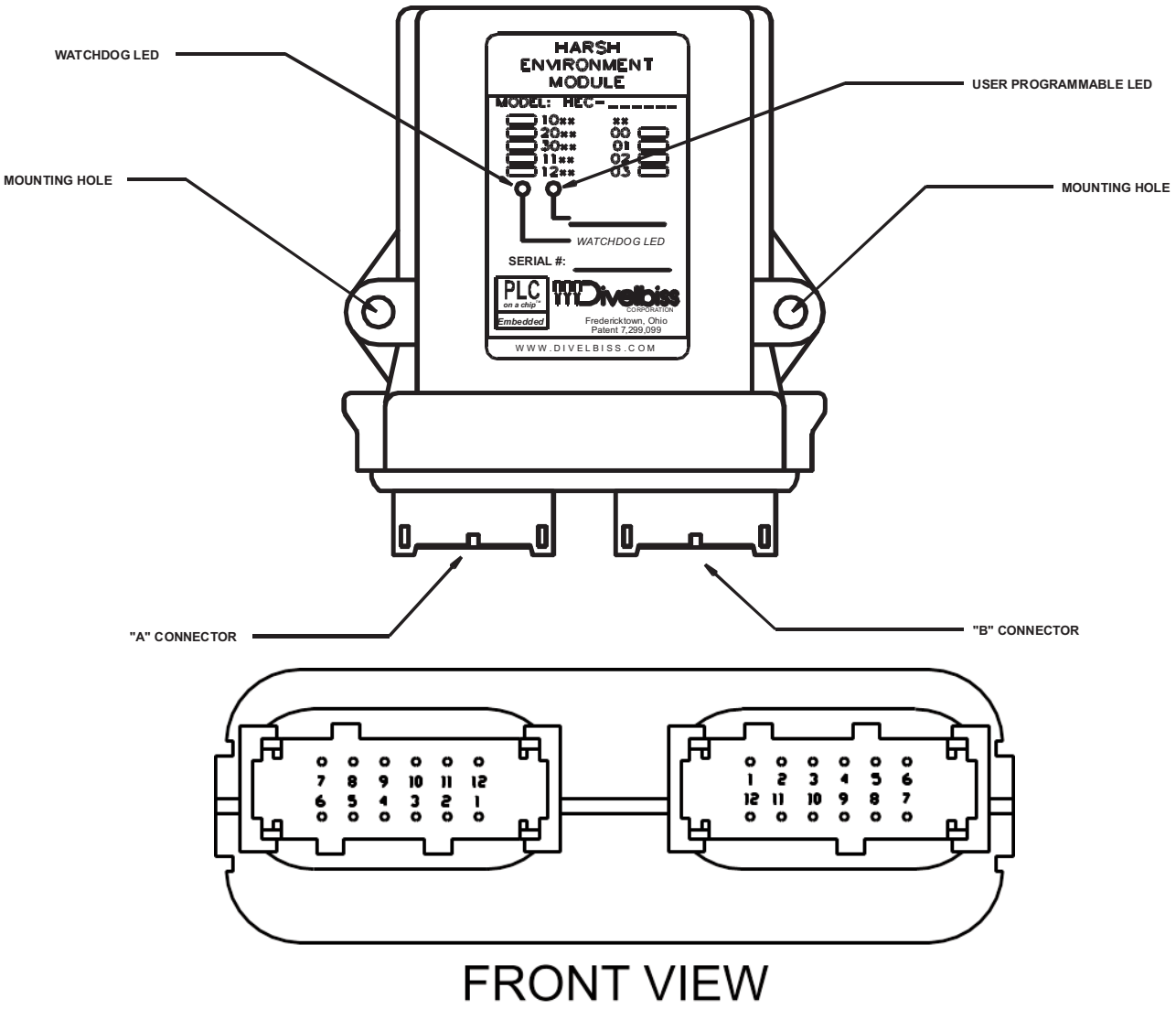
12. Click **OK** to close the *ProjectSettingsForm* dialog and save the changes.

The PWM channels are now ready for use using the PWM and PWM_FREQ functions. Refer to EZ LADDER Manual - Section 10 for details on using and configuring these functions.

HEC-20XX FEATURES

This section describes the HEC-20XX hardware features and options including using EZ LADDER to operate the hardware.

GETTING TO KNOW THE HEC-20XX



The HEC-20XX is connected to external devices and programmed using its 'A' and 'B' connectors. The mating connectors for the HEC-20XX may be purchased as kits. There are several kits available to aid in the wiring of the HEC-20XX including a kit that has allows the serial port to be used without changing additional I/O wiring.

Connector Pin outs

CONNECTOR 'A' (GRAY)

Pin 1	Input 4 (GPI4)
Pin 2	Input 5 (GPI5)
Pin 3	CAN Hi
Pin 4	CAN Low
Pin 5	Programming Port TX
Pin 6	Programming Port RX
Pin 7	+VDC Input Power
Pin 8	+VDC Input Power
Pin 9	+VDC Input Power
Pin 10	-DC / Input Power Common
Pin 11	Input 7 (GPI7) / CNTR2
Pin 12	Input 6 (GPI6) / CNTR1

CONNECTOR 'B' (BLACK)

Pin 1	Output 0 / PWM 0 (GPO0/PWM0)
Pin 2	Output 1 / PWM 1 (GPO1/PWM1)
Pin 3	Output 2 / PWM 2 (GPO2/PWM2)
Pin 4	Output 3 / PWM 3 (GPO3/PWM3)
Pin 5	Output 4 / PWM 4 (GPO4/PWM4)
Pin 6	Output 5 / PWM 5 (GPO5/PWM5)
Pin 7	Input 0 (GPI0)
Pin 8	Input 1 (GPI1)
Pin 9	Input 2 (GPI2)
Pin 10	Input 3 (GPI3)
Pin 11	Output 7 / PWM 7(GPO7/PWM7)
Pin 12	Output 6 / PWM 6(GPO6/PWM6)

Figure 2.1 - HEC-20XX Features

HEC-20XX MOUNTING

The HEC-20XX mounts simply using two mounting screws. The HEC can easily accept mounting screws up to 1/4" in diameter.

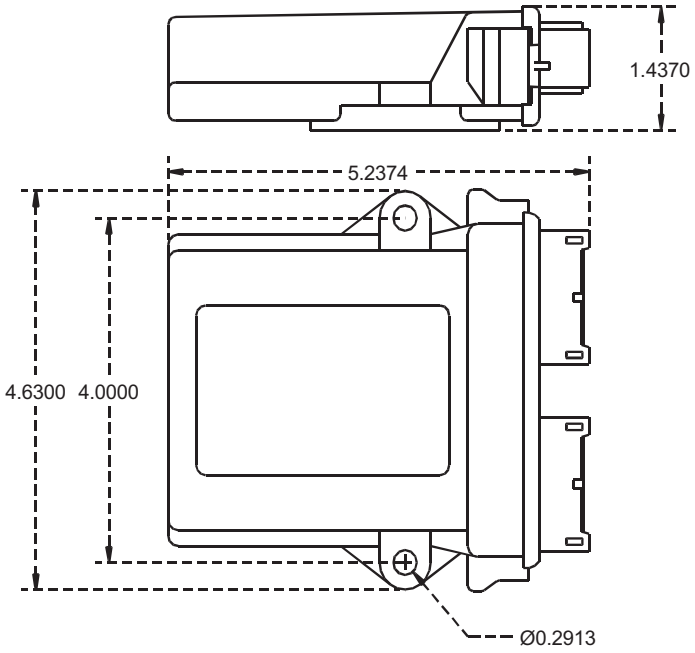


Figure 2.2 - HEC-20XX Mounting

HEC-20XX INPUT POWER

The HEC-20XX may be powered using 8-32VDC. The input power must be of sufficient supply to drive the HEC controller and all the digital outputs (based on the load currents for each). Due to wire size limitations of the HEC-20XX connectors, multiple input power pins are provided to allow for 'parallel' input power lines to increase the amount of current (for heavier output loads). See Figure 2.3.

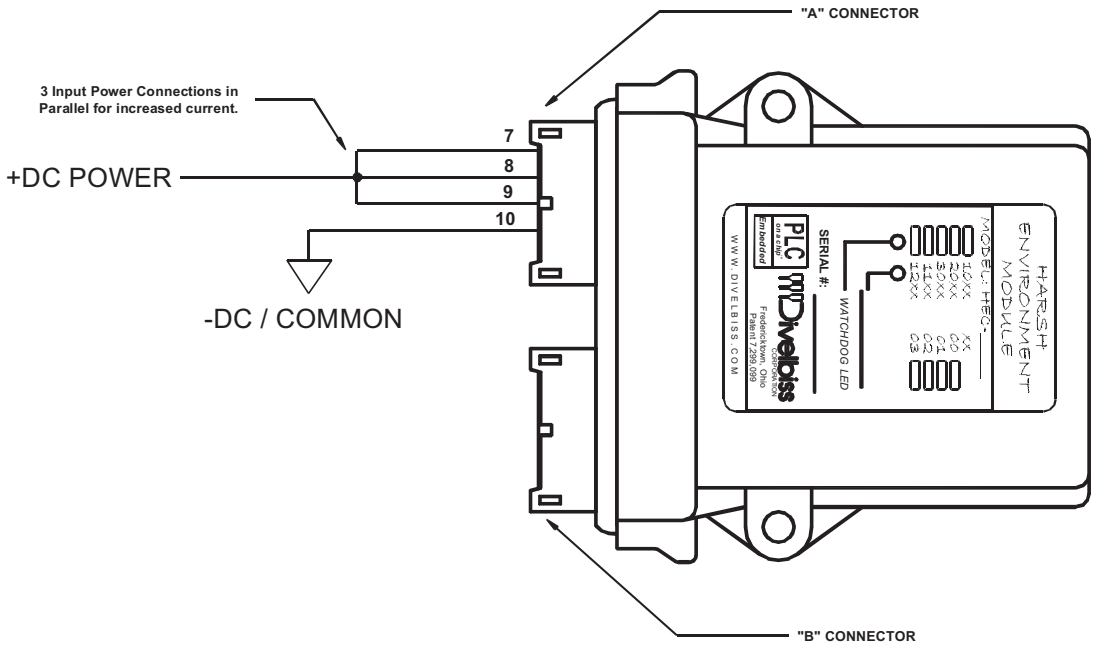


Figure 2.3 - HEC Input Power

WATCHDOG LED

The operating status of the HEC-20XX can be determined the by Watchdog LED. When the Watchdog LED is flashing at a slow rate, approximately once per second, then there is no program executing. When the Watchdog LED is flashing at a fast rate, approximately 10 times per second, a program has been loaded and it is executing.

Should the Watchdog LED not flash at all, first check the input power. If the input power is correct and there is still no Watchdog LED, contact Divelbiss Technical Services.

PROGRAMMING PORT - COM 0

The HEC-20XX is programmed using its Programming Port (COM 0). This RS232 serial port is only to be used for programming with Divelbiss' EZ LADDER. The Programming Port defaults to 57600,N,8,1. This is not a general purpose port. See Figure 2.4

The HEC-20XX is connected to external devices and programmed using its 'A' and 'B' connectors. The mating connectors for the HEC-20XX may be purchased as kits. There are several kits available to aid in the wiring of the HEC-20XX including a kit that has allows the serial port to be used without changing additional I/O wiring (P/N HEC-900 or HEC910). See Figure 2.5.

When connecting EZ LADDER to the HEC-20XX (using the Serial Port Breakout Kit), the programming port requires a null modem connection. This cable may be purchased from Divelbiss (use Part Number: ICM-CA-34).

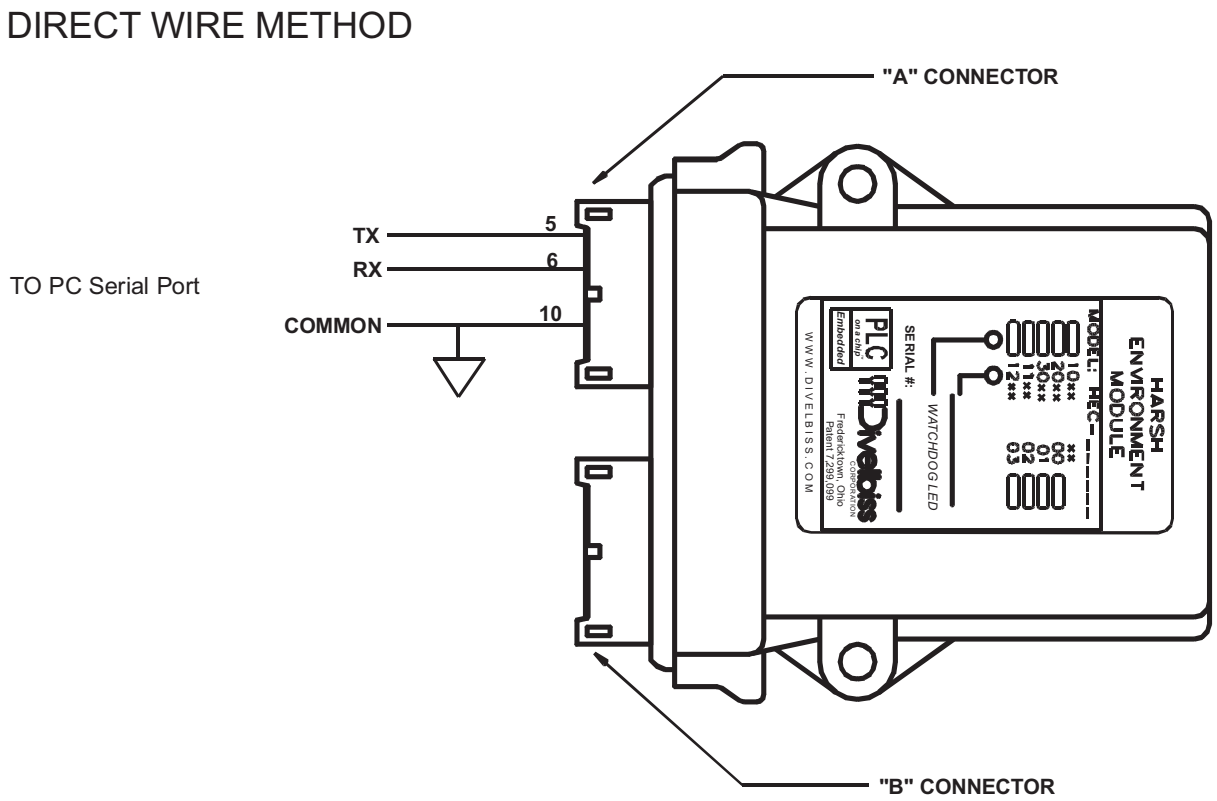


Figure 2.4 - Programming Port, Direct Wire Method

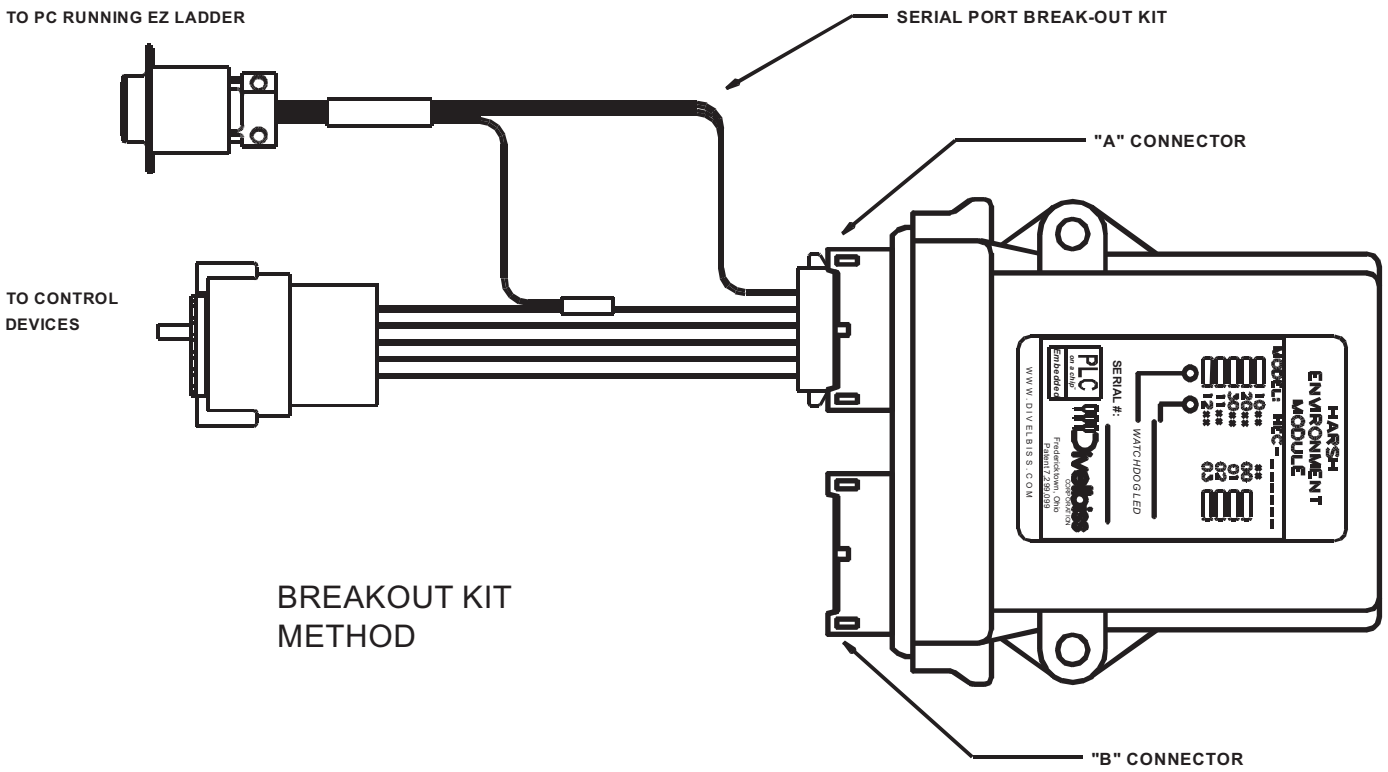


Figure 2.5 - Programming Port, Breakout Method

GENERAL PURPOSE SERIAL PORT

The HEC-20XX optionally may be ordered with a second serial port. This serial port is a general purpose serial port that supports serial printing and Modbus Slave. This port may be factory ordered as HEC-2001 (RS232), HEC-2002 (RS422) or HEC-2003 (RS485). The serial port is accessed by a factory installed cable with an industry standard M8 connector. The HEC-2000 does not have a general purpose serial port.

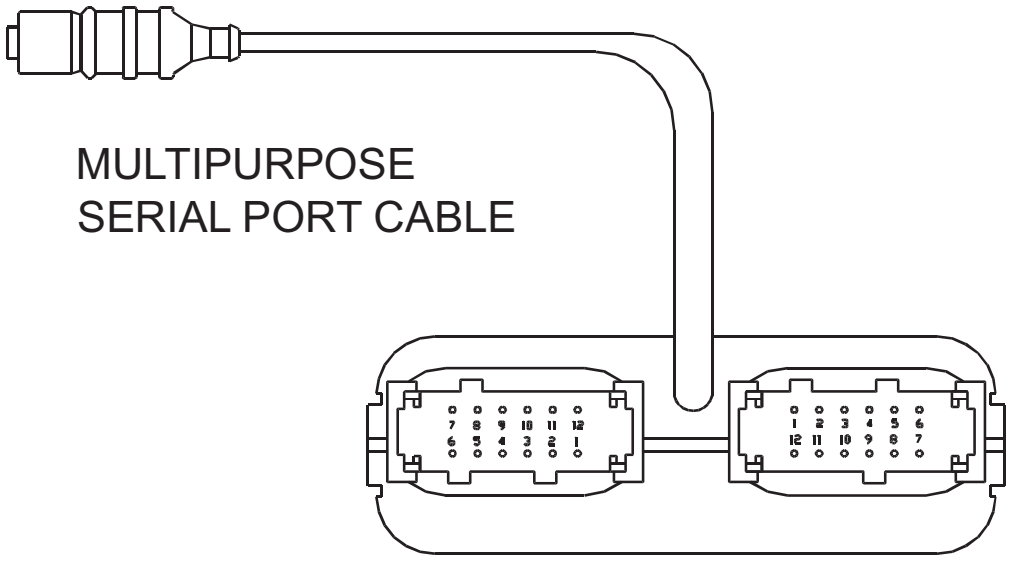


Figure 2.6 - Multipurpose Serial Port Cable

Multipurpose Serial Port Pin-Out

RS232 Serial Port - HEC-2001

Pin	ID	Description
1	RX	Receive Data
2	TX	Transmit Data
3	GND	Ground
4	RTS	Request to Send

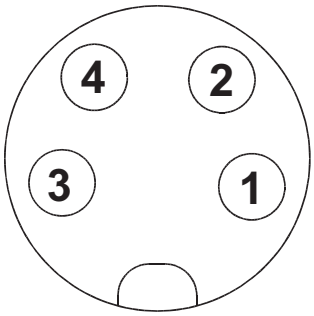
RS485 Serial Port - HEC-2003

Pin	ID	Description
1	TX+	Data (+)
2	TX-	Data (-)
3	GND	Ground
4	--	No Connect

RS422 Serial Port -HEC-2002

Pin	ID	Description
1	RX-	Receive Data (-)
2	RX+	Receive Data (+)
3	TX+	Transmit Data (+)
4	TX-	Transmit Data (-)

FRONT OF CABLE CONNECTOR



The Multipurpose serial port cable cover is available. Order using Divelbiss Part # 120-106189

CAN PORTS

The HEC-20XX provides one on-board CAN bus interface port. CAN Port 0 may be used for the Divelbiss OptiCan Network or J1939 communications.

TYPICAL OptiCAN NETWORK OR J1939CONNECTIONS

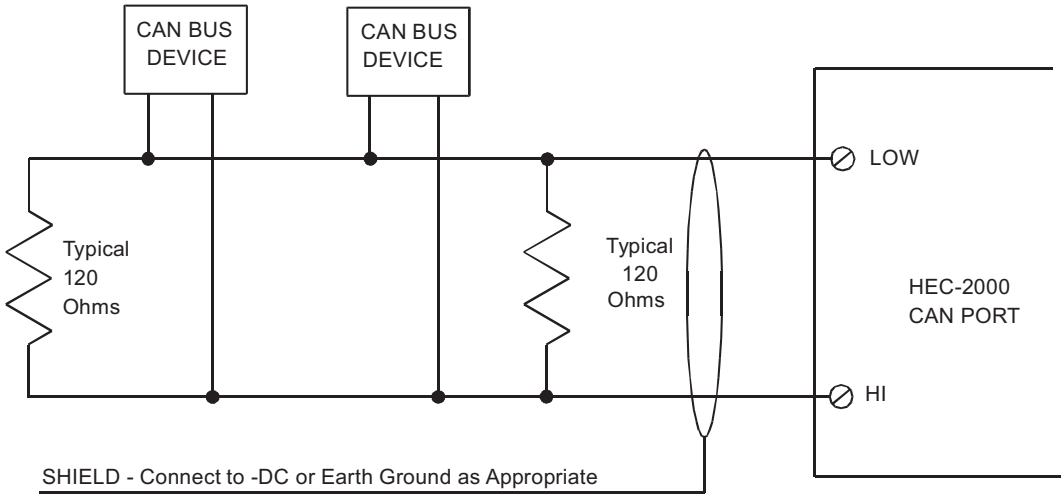


Figure 2.7 - Typical CAN Network Connections

DIGITAL INPUTS

The HEC-20XX includes 8 on-board digital inputs. They are identified as GPI0 - GPI7 and can accept an input voltage of 8-32VDC.

It is important that the input device source be the same as the HEC-20XX input power source as shown. Separate power sources could result in a damage to the controller if input power is lost, but the inputs are still powered.

GPI6 and GPI7 may be used as general purpose inputs or high speed counters; while GPI0 - GPI5 can only be used as general purpose inputs. For information on using GPI6 or GPI7 as high speed counter inputs, refer the COUNTER INPUTS Section of this manual.

To access the digital inputs in the ladder diagram, use the DIRECT CONTACT and INVERTED CONTACT objects. These inputs can be monitored using their variable names that are automatically created when the target is selected (GP10 through GPI7).

GPI6 and GPI7 are desiged with software switchable debounce circuitry. For those times when using the GPI6 or GPI7 as a digital input and hardware debounce would be desirable, the on-board debounce circuit can be enabled to operate with the use of a coil in the EZ LADDER program. The outputs are automatically created when the target is configured. The output variable names that control the debounce for GPI6 and GPI7 are DB_GPI6 and DB_GPI7 respectively.

When using GPI6 or GPI7 as a counter, typically the debounce should be disabled (default mode of operation).

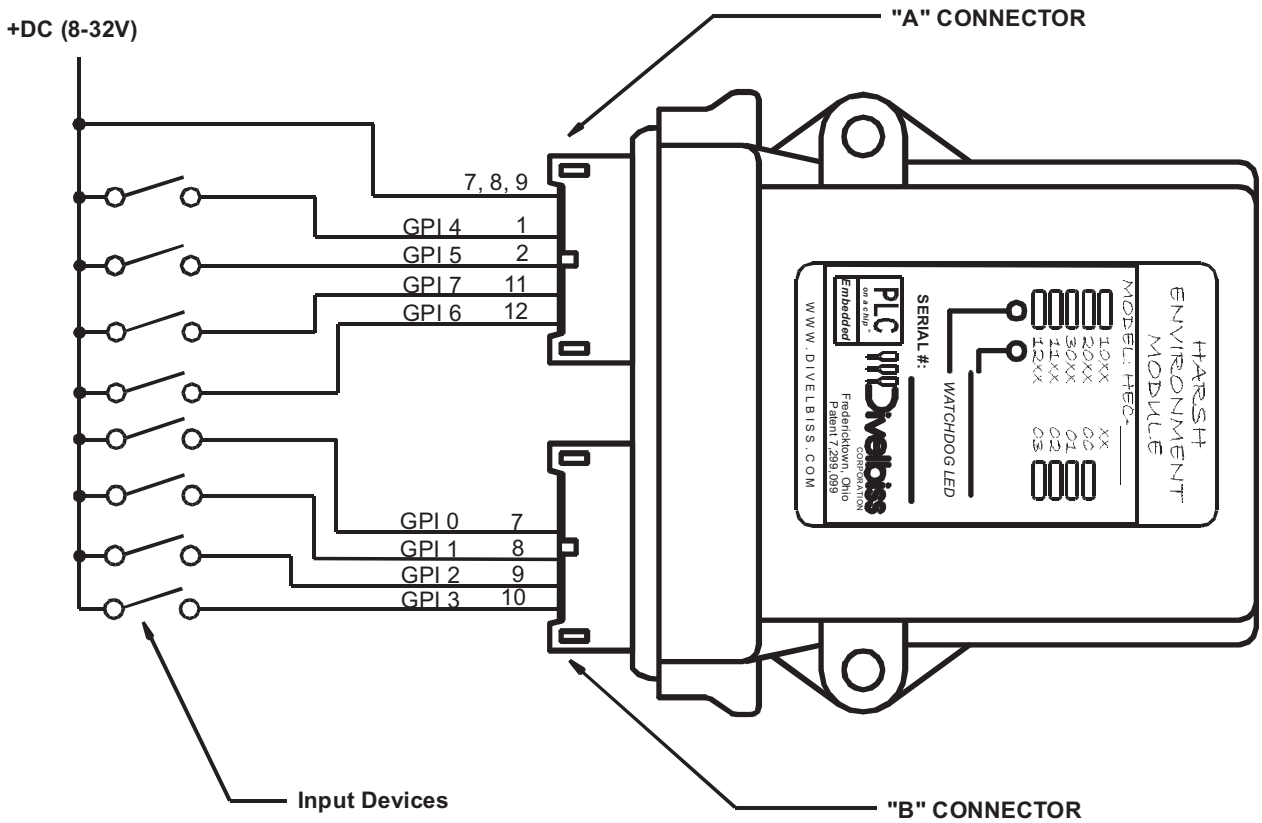


Figure 2.8 - Typical Digital Input Connections

COUNTER INPUTS

Two of the digital inputs (GPI6, GPI7) may be utilized as high speed counters (up count). These inputs will accept a maximum frequency of 40KHz and are optically isolated to promote noise immunity. High speed counter inputs use the EZ LADDER function: CNTRTMR.

GPI6 and GPI7 are desiged with software switchable debounce circuitry. For those times when using the GPI6 or GPI7 as a digital input and hardware debounce would be desirable, the on-board debounce circuit can be enabled to operate with the use of a coil in the EZ LADDER program. The outputs are automatically created when the target is configured. The output variable names that control the debounce for GPI6 and GPI7 are DB_GPI6 and DB_GPI7 respectively.

When using GPI6 or GPI7 as a counter, typically the debounce should be disabled (default mode of operation).

Typical High Speed Counter connections are shown in Figure 2.9.

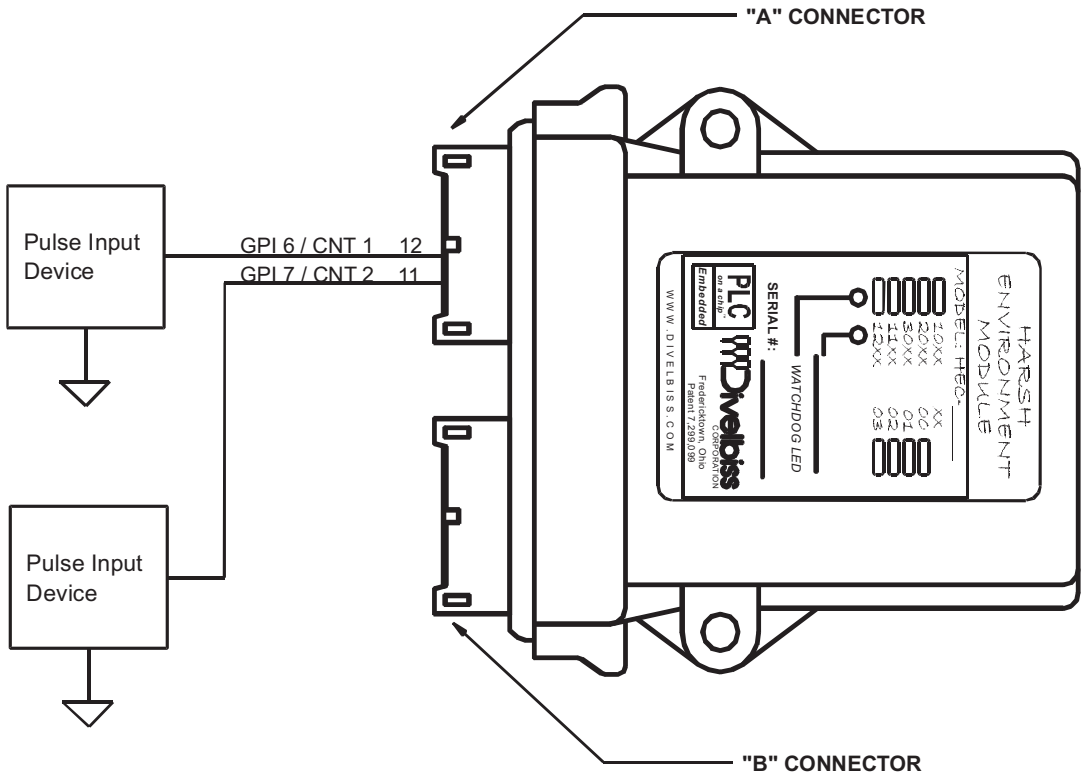


Figure 2.9 - Typical Counter Input Connections

DIGITAL OUTPUTS

The HEC-20XX includes 8 on-board digital outputs. They are identified as GPO0 - GPO7. The output voltage will be equal to the HEC-20XX's input voltage. Each output can drive a load up to 3 Amps maximum (resistive) and includes an automatic over-current shutdown safety that resets when the output is turned off (set to false) in the ladder diagram. Depending upon the device connected to an output, a minimum load resistor may be required. If the output is "ON" at all times, connect a 470Ω to 1KΩ load from the output to common.

Each digital output may also be configured as a PWM output. Each output may only be used as either digital output or PWM output. For information on using digital outputs as PWM outputs, refer the PWM Outputs Section of this manual.

To access the digital outputs in the ladder diagram, use the DIRECT COIL and INVERTED COIL objects. Use the variable names (automatically created when the target is selected, GPO0 to GPO7) with the objecst to control the outputs.

The status of each digital output may be 'monitored' for an OK or Fault status. When the HEC-20XX target is configured in EZ LADDER, 8 status variables are created automatically (*STAT0 - STAT7*). These variables indicate the status of the output and may be used in the program as any boolean variable (or direct or inverted contact). A *High* or *True* condition indicates that the output is functioning properly while a *Low* or *False* condition indicates a fault condition of the output (open load or overload).

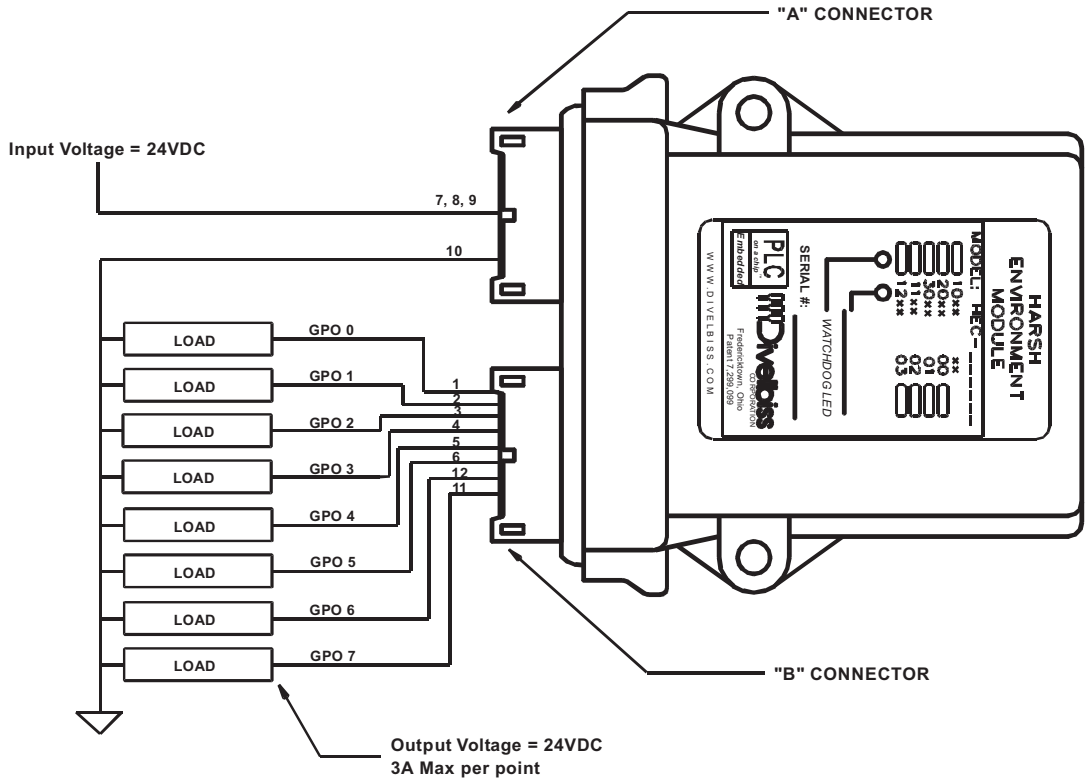


Figure 2.10 - Typical Digital Output Connections

PWM OUTPUTS

As previously noted, the HEC-20XX includes 8 on-board digital outputs that may be configured as a PWM outputs. Each output may only be used as either digital output or PWM output. Before the PWM outputs may be used in the ladder diagram, the PWM output software support must be installed using EZ LADDER's Target Configuration. See Section 1 for details on installing and configuring the PWM option.

Each output used as a PWM channel will operate at a programmable frequency of 1.426Hz to 1KHz with a duty cycle of 5-95%. For duty cycles of less than 5% or greater than 95%, the maximum frequency is 100Hz.

Figure 2.10 shows the typical connections for using the outputs as PWM channels.

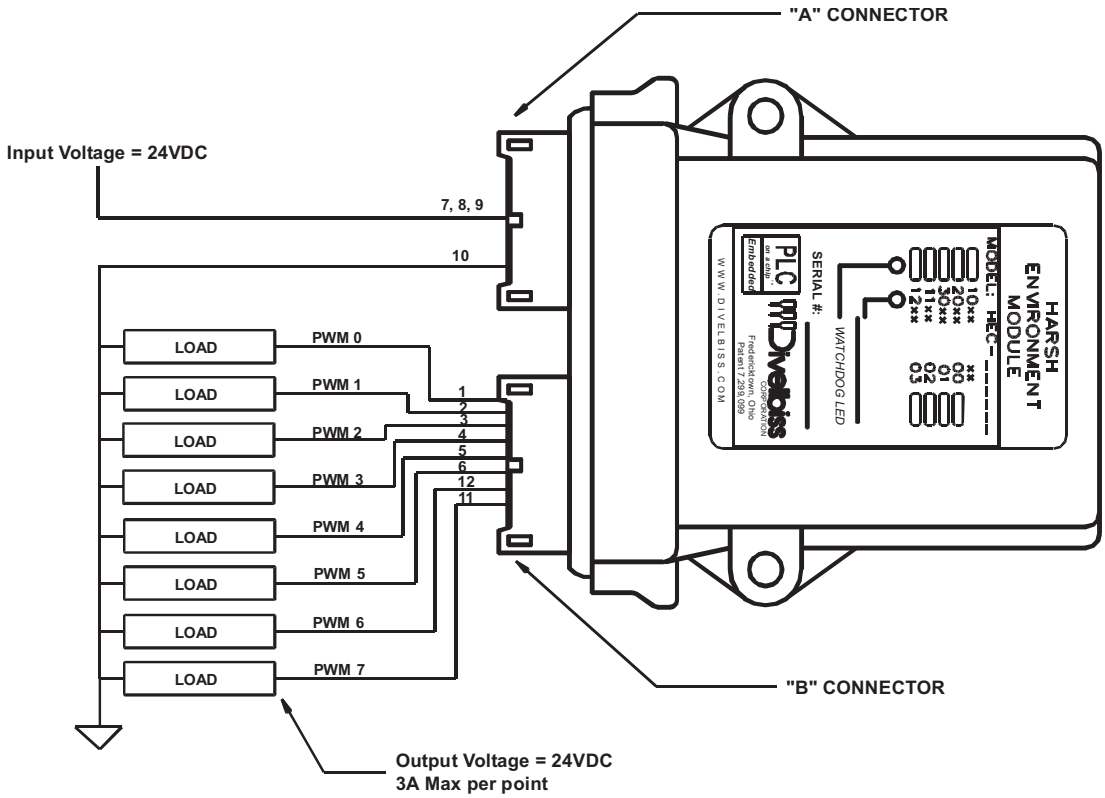


Figure 2.11 - PWM Connections

SPECIFICATIONS

Processor:	PLC on a Chip™
Memory:	256K Flash, 12K RAM
Serial Ports:	1 Programming Port (Max baud: 57.6K); 1 Multipurpose Port, Factory Configured as RS232, RS422 or RS485 (Excluding HEC-2000)
Networking:	1 CAN Ports for Divelbiss OptiCan and J1939 Communications
Digital I/O:	8 Inputs & 8 Outputs on-board, Expandable using HEC Network Inputs rated 8-32VDC Outputs rated @ 3A Maximum (resistive), Over-current protected. Output Voltage = Input Power
Counters:	2 Channels, Count Up, 40KHz Max. (using Digital Inputs 6 and 7)
PWM Outputs:	8 Channels, PWM frequency programmable from 1.436Hz to 1KHz with a duty cylce of 5%-95%, Overcurrent Protected, Output Voltage=Input Voltage, Sourcing rated at 3A Maximum.
Power Requirements:	8-32VDC
Operating Temp:	-40-70º C
Program Language:	Ladder Logic using Divelbiss EZ LADDER.
Dimensions:	3.62” Wide x 5.21” Length x 1.21” Tall.
Mounting:	Panel Mount using screws
Type:	NEMA 4X, Enclosed, Sealed Plastic Housing
Storage Temperature:	-40-85ºC